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Electric scooters: batteries in the battle against ambient air pollution?



Ambient air pollution is a major global health threat, responsible for an estimated loss of 103 million disability-adjusted life-years in 2015,^{1,2} and a main contributor to numerous health problems, such as cardiovascular and respiratory diseases.^{3,4} Within the traffic domain of air pollution, cars, lorries, busses, mopeds, and scooters are all partly responsible, with the latter being of particular importance regarding, amongst others, black carbon, carcinogenic benzene, and (ultrafine) particulate matter exhaust.⁵

In the last decade, most traffic-related anti-air pollution policy focused on reduction of emissions from cars, busses, and lorries, especially because diesel fuel was thought to be the main source of pollution. Regulations on scooter emission lagged behind for a long time, yet promising policy developments seem to be imminent. Strict European Union regulations effective from 2018 onwards will restrict the sale of the most polluting scooters—ie, those with a two-stroke engine type. At the same time, new electric scooters (e-scooters) could help reduce the burden of air pollution.

From summer, 2017, the citizens of Amsterdam, Netherlands, will be able to benefit from a shared e-scooter initiative, following San Francisco, Paris, and Barcelona. At first sight, the absolute impact of introduction of e-scooters in the so-called bicycle capital of the world might be considered moderate given the relative low number of scooters compared with regular bicycle users. However, these regular cyclists have relatively high air pollution exposure due to their elevated respiratory minute volume combined with the short distance between scooters and cyclists on Dutch bicycle lanes.

On a more global scale, and taking into account the popularity of two-stroke scooters and less stringent regulations in regions such as Asia and Africa, the expected health effects of e-scooter introduction are substantial.⁶ In Vietnam's capital city Hanoi, steep economic development and fast urbanisation have been associated with a rapid increase in the vehicle fleet, with an annual growth of about 15% in the number of motorcycles. Traffic contributes largely to the air

pollution in the city, and accounts for about 70% of the total pollution, with profound peaks during the morning and afternoon rush hours. Calculation of the health risks caused by traffic shows that daily commuting in Hanoi causes a substantial health burden. In 2009, traffic exhaust caused more than 3000 deaths.⁷ In addition, the prevalence of chronic obstructive pulmonary disease in non-smoking inhabitants of urban Vietnam is more than 10% which seems, next to indoor air pollution, to be partly as a result of heavy traffic air pollution.⁸ Therefore, Vietnam has launched the Vietnam-Integrated Action Plan to Reduce Vehicle Emission,⁹ with its main goal to reduce mobile sources of air pollution in Vietnam's largest cities. Specific subgoals include the facilitation of use of alternative fuels, environmentally friendly vehicles, and implementation of energy efficiency measures in the transport sector. E-scooters are considered one of the promising solutions for this Action plan and offer an acceptable alternative for urban citizens having to travel daily distances of 20–25 km with frequent traffic jams during which they are exposed to pollution for several hours.

Strict scooter emission regulations and the stimulation of e-scooters could also have striking effects elsewhere in the Asian region. In Guangzhou (China), benzene, toluene, ethylbenzene, and xylene concentration levels



Figure: Boda boda

dropped from 228 $\mu\text{g}/\text{m}^3$ to 37 $\mu\text{g}/\text{m}^3$ after a total ban of scooters from the inner city in 2005.⁵ The same may hold true for Africa. For example, in Kampala (Uganda), a city where 300 000 scooters called boda bodas operate (figure), dangerously high concentrations of air pollutants have been reported.¹⁰ Replacement of two-stroke scooters with e-scooters would greatly reduce air pollution here too.

The technology is available and it may seem time for large scale adoption. Yet several challenges have to be overcome. The comparatively high price of e-scooters might necessitate government subsidies, safety will remain an issue (in Shanghai and Beijing, scooters were banned from public roads in summer, 2016, for safety reasons), and battery life may be problematic so sufficient charging points will be needed, as well as parking places.

In conclusion, e-scooters seem to offer a promising solution in the battle against air pollution, sustainable energy use and healthy living environments. Implementation generally takes several years however, and traditional polluting scooters do still largely outnumber their e-variants. Will the battery eventually win the battle?

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We declare no competing interests.

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